Abstract

The present invention discloses an adaptive near-far resistant receiver for wireless communication systems, such as, asynchronous DS-CDMA systems, without the use of prior synchronization. The only requirement is knowledge of the spreading code of the desired user. Also there is no need of a training period or of data-free observations. In one aspect the present system describes a method and system for filtering of an asynchronous wireless signal comprising the steps of receiving a data vector; of using the received data vector to update the weight coefficients of an adaptive filter without a prior knowledge of synchronization and without a need for a separate training period or data free observations.

In another aspect, the present system describes an adaptive near-far resistant receiver for an asynchronous wireless systems comprising means for receiving a data vector; means for; using the received data vector to update weight coefficients of an adaptive filter, and means for iterative multistage decomposition updating of the filter coefficients. In one embodiment the receiver uses an adaptive filter bank comprising a plurality of adaptive filters, wherein each filter corresponds to at least one different sampling time. An estimate of the timing is obtained from the maximum of a set of sequential outputs from the filter bank, The output that yields the maximum is preferably used to demodulate the information bit.

Appendix A

A. Gold Sequence Generator

Due to the large range of values of the cross-correlations of the maximum-length shift-register sequence, sometimes called *m*-sequence, they usually are not adopted to CDMA-like applications. PN-sequences with better periodic cross-correlation properties than *m*-sequences are given by the sequences of Gold (1967, 1968) and Kasami (1966), where the two-values of their sequences are +1 and –1. In Robert Gold, "Maximal recursive sequences with 3-valued recursive cross-correlation functions," *IEEE Trans. on Inform. Theory*, vol. 41, pp. 154-156, January 1968 [21], the contents of which are hereby expressly incorporated by reference, it was proved that certain pairs of *m*-sequences of length N exhibit a three-valued cross-correlation function [21] with the values -1, $-t(m)$, $t(m)-2$}, where

$$t(m) = \begin{cases} 2^{(m+2)/2}+1 & (\text{odd } m) \\ 2^{(m+2)/2}+1 & (\text{even } m) \end{cases}$$

and where m denotes an m-stage shift register of sequence length $N = 2^m - 1$.

Consider the generation of the Gold sequences of length $N = 31 = 2^5 - 1$ with the pair of preferred sequences, that are obtained from the book by Peterson and Weldon (W. W. Peterson and E. J. Weldon, *Error Correcting Codes*, MIT Press, Cambridge, MA, 1972 [22], the contents of which are hereby expressly incorporated by reference) are described by the polynomials,

$$\begin{aligned} g_1(D) &= D^5+D^2+1, \\ g_2(D) &= D^5+D^4+D^3+D^2+1 \end{aligned}$$

Let b and b' represent the two m-sequences with period $N = 31$ that are generated by $g_1(D)$ and $g_2(D)$, respectively. The Gold family for the sequences of length 31 comprises of 2^m+1 = 33 sequences given in R. L. Peterson, R. E. Ziemer, and D. E. Borth, *Introduction to Spread Spectrum Communications*, Prentice Hall, Englewood Cliffs, NJ, 1995 [23], the contents of which are hereby expressly incorporated by reference, by

$$G = \{b\} \cup \{b'\} \cup \{ \{ b + D^{\tau} b' \} \mid 0 \leq \tau \leq N-1 \}, \tag{56}$$

where the term $D^{\tau}b'$ represents a phase shift of the m-sequence b' by τ units and "∪" denotes set union. The sequences s_1 and s_2 in the example of Section 2 are derived by setting τ in Eq. (56) equal to 0 and 1, respectively.